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Conventional echocardiographic assessment of the canine right heart: reference intervals and repeatability☆

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Abstract *Introduction:* We sought to define reference intervals for echocardiographic dimensions of the canine right heart. Secondarily, we intended to describe measurement variability of these dimensions.
Animals: Forty-five healthy adult pet dogs of diverse somatotype.
Materials and Methods: To obtain normative data used to define reference intervals, dogs underwent one echocardiographic examination by the same operator. Raw data were subject to logarithmic (log_{10}) transformation and allometric relationships between body weight and echocardiographic variables were determined; reference intervals intended to include 95% of the population were defined. Six of the 45 dogs were randomly selected and subject to repeated echocardiographic examination by two operators. Measurement variability was quantified through calculation of coefficients of variation and repeatability coefficients.
Results: The strength of the linear relationships between log_{10} transformed echocardiographic variables and body weight varied; the range of coefficients of determination (R^2) was 0.055—0.872. For most variables the scaling exponents were close to values expected based on presumed allometric relationships. Of the 190 within-day, between-day and inter-operator coefficients of variation generated, 165 (87%) were less than 15%. Analysis of variance revealed the operator to be a significant source of variation for 25 of 38 measurements.

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Conclusions: Reference intervals for echocardiographic dimensions and indices of right heart function are proposed. Repeatability of selected linear dimensions and areas obtained from two-dimensional echocardiography likely is sufficient for longitudinal clinical evaluations.

Abbreviations

2DE	two-dimensional echocardiography
%FAC	right ventricular fractional area change
ASE	American Society of Echocardiography
$Ao^{rp\text{-}sax}$	aortic root diameter from right parasternal short-axis image
$Ao^{M\ lp\text{-}sax}$	aortic root diameter from M-mode directed by left parasternal short-axis image
CV	coefficient of variation
CVC	caudal vena cava diameter
$MPA^{lp\text{-}cran}$	main pulmonary artery diameter from left parasternal cranial image
$PV^{lp\text{-}cranial}$	pulmonic valve hinge-point diameter from left parasternal cranial image
$PV^{rp\text{-}sax}$	pulmonic valve hinge-point diameter from right parasternal short-axis image
RAA^{apex}	right atrial area at end-systole from left parasternal apical image
$RAA^{rp\text{-}lax}$	right atrial area at end-systole from right parasternal long-axis image
$RA\text{-}maj^{apex}$	right atrial major dimension at end-systole from left parasternal apical image
$RA\text{-}maj^{rp\text{-}lax}$	right atrial major dimension at end-systole from right parasternal long image
$RA\text{-}min^{apex}$	right atrial minor dimension at end-systole from left parasternal apical image
$RA\text{-}min^{rp\text{-}lax}$	right atrial minor dimension at end-systole from right parasternal long image
RC	repeatability coefficient
RVA_d^{apex}	end-diastolic right ventricular area from left parasternal apical image
RVA_s^{apex}	end-systolic right ventricular area from left parasternal apical image
$RV\text{-}maj_d^{apex}$	end-diastolic right ventricular major dimension from left parasternal apical image
$RV\text{-}maj_s^{apex}$	end-systolic right ventricular major dimension from left parasternal apical image
$RV\text{-}min_d^{apex}$	end-diastolic right ventricular minor dimension from left parasternal apical image
$RV\text{-}min_d^{M}$	end-diastolic right ventricular minor dimension from M-mode directed by right parasternal image
$RV\text{-}min_d^{rp\text{-}lax}$	end-diastolic right ventricular minor dimension from right parasternal long-axis image
$RV\text{-}min_s^{apex}$	end-systolic right ventricular minor dimension from left parasternal apical image
$RV\text{-}min_s^{M\ rp\text{-}sax}$	end-systolic right ventricular minor dimension from M-mode directed by right parasternal short-axis image
$RV\text{-}min_s^{rp\text{-}lax}$	end-systolic right ventricular minor dimension from right parasternal long-axis image
$RVOT^{lp\text{-}cran}$	right ventricular outflow tract diameter from left parasternal cranial image
RVW_d^{apex}	end-diastolic right ventricular wall thickness from left parasternal apical image
$RVW_d^{M\ rp\text{-}sax}$	end-diastolic right ventricular wall thickness from M-mode directed by right parasternal short-axis image
$RVW_d^{rp\text{-}lax}$	end-diastolic right ventricular wall thickness from right parasternal long-axis image
RVW_s^{apex}	end-systolic right ventricular wall thickness from left parasternal apical image
$RVW_s^{M\ rp\text{-}sax}$	end-systolic right ventricular wall thickness from M-mode directed by right parasternal short-axis image
TAPSE	tricuspid annular plane systolic excursion
TVA_d^{apex}	end-diastolic tricuspid valve annulus dimension from left parasternal apical image
TVA_s^{apex}	end-systolic tricuspid valve annulus dimension from left parasternal apical image